



June 1993

## SASS v.2.1: Anthropometric Spreadsheet and Database for the IRIS

Francisco Azuola  
*University of Pennsylvania*

Susanna Wei  
*University of Pennsylvania*

Teo Kok Hoon  
*University of Pennsylvania*

Norman I. Badler  
*University of Pennsylvania, badler@seas.upenn.edu*

Follow this and additional works at: [https://repository.upenn.edu/cis\\_reports](https://repository.upenn.edu/cis_reports)

---

### Recommended Citation

Francisco Azuola, Susanna Wei, Teo Kok Hoon, and Norman I. Badler, "SASS v.2.1: Anthropometric Spreadsheet and Database for the IRIS", . June 1993.

University of Pennsylvania Department of Computer and Information Science Technical Report No. MS-CIS-93-63.

This paper is posted at ScholarlyCommons. [https://repository.upenn.edu/cis\\_reports/280](https://repository.upenn.edu/cis_reports/280)  
For more information, please contact [repository@pobox.upenn.edu](mailto:repository@pobox.upenn.edu).

---

## SASS v.2.1: Anthropometric Spreadsheet and Database for the IRIS

### Abstract

This report is the user's manual of *SASS v.2.1*, the Spreadsheet Anthropometric Scaling System (version 2.1). It describes the usage of *SASS*, a spreadsheet-like system which allows flexible interactive access to all anthropometric variables needed to size a computer-based human figure, described structurally by a *PEABODY* file. Data that may be accessed is organized into the following "groups": segment dimension ("girth"), joint limits, center of mass, and strength, all of which work based on statistical population data. *SASS* creates generic computer-based human figures based on this data. *SASS* also is an anthropometric database and interactive query system that works upon anthropometric data of real individuals. Scaled computer-based human figures created by *SASS* can be displayed directly, and interactively changed, within the *Jack* software.

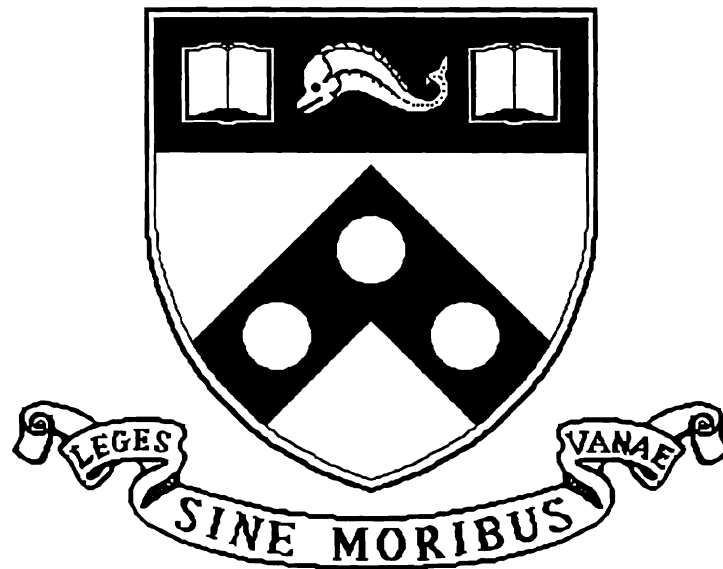
### Comments

University of Pennsylvania Department of Computer and Information Science Technical Report No. MS-CIS-93-63.

**SASS v.2.1**  
**Anthropometric Spreadsheet and Database**  
**For The IRIS**

**MS-CIS-93-63**  
**GRAPHICS LAB 57**

**Francisco Azuola**  
**Susanna Wei**  
**Teo Ko Hoon**  
**Norman I. Badler**



**University of Pennsylvania**  
**School of Engineering and Applied Science**  
**Computer and Information Science Department**  
**Philadelphia, PA 19104-6389**

**June 1993**

**SASS v.2.1**  
**Anthropometric Spreadsheet and**  
**Database**  
**for the IRIS**

**Francisco E. Azuola**  
**Sussana Wei**  
**Teo Kok Hoon**  
**Norman I. Badler**

**Technical Paper**  
**University of Pennsylvania - Graphics Lab**

June 22, 1993

# Contents

<b>1</b>	<b>Introduction</b>	<b>4</b>
1.1	Using This Manual . . . . .	4
1.2	For Experienced Users . . . . .	4
1.3	Installing the Program . . . . .	6
1.4	Notational Conventions . . . . .	8
<b>2</b>	<b>A Short SASS Tutorial</b>	<b>10</b>
2.1	Starting the Program . . . . .	10
2.2	Scrolling . . . . .	11
2.3	Creating output files . . . . .	11
2.4	Saving the spreadsheet contents and Quitting . . . . .	11
2.5	Advanced Tutorial . . . . .	12
<b>3</b>	<b>SASS Reference Manual</b>	<b>18</b>
3.1	Anthropometric Spreadsheet . . . . .	18
3.1.1	Anthropometric Group Status . . . . .	18
3.1.2	Global Data . . . . .	18
3.1.3	Data Section . . . . .	19
3.1.4	Command Menu . . . . .	19
3.1.5	<b>SASS</b> Hot Keys . . . . .	21
3.1.6	<b>SASS</b> Pull Down Menu . . . . .	21
3.1.7	Dialog Line . . . . .	22
3.1.8	Dialog Box . . . . .	22
3.1.9	Resizing the Window . . . . .	22
3.1.10	Scrolling . . . . .	22
3.1.11	Making Selections with the Mouse . . . . .	23
3.1.12	On-Line Help . . . . .	23
3.1.13	<b>SASS</b> Special Modes . . . . .	23
3.1.14	Reading a file . . . . .	24
3.1.15	Saving the spreadsheet contents . . . . .	24
3.1.16	Clearing up the sheets . . . . .	24
3.2	Strength Sheet . . . . .	24
3.3	SASS-Jack Interface . . . . .	25
3.3.1	Figure Scaling . . . . .	25
3.3.2	Figure Creation . . . . .	26
3.4	Database Query Spreadsheet . . . . .	26
3.4.1	Summary Data Section . . . . .	27
3.4.2	Query List Section . . . . .	27
3.4.3	Scroll Buttons . . . . .	27
3.4.4	Command Menu . . . . .	27
3.5	Exit <b>SASS</b> . . . . .	32
3.6	<b>SASS</b> in Depth . . . . .	32

3.6.1	The hierarchy of the human figure . . . . .	33
3.6.2	The rule system . . . . .	33
3.6.3	Rules in <b>SASS</b> : Stature Definition . . . . .	33
3.6.4	Object level . . . . .	34
3.6.5	What is an object? . . . . .	35
<b>4</b>	<b>Tricks</b>	<b>39</b>
<b>5</b>	<b>Bibliography</b>	<b>41</b>
<b>6</b>	<b>Appendix</b>	<b>42</b>
6.1	Database Format . . . . .	42
6.2	Hot Keys . . . . .	43
6.3	Pull-down menu . . . . .	44
6.4	Contents by Topic . . . . .	45

## Abstract

This report is the user's manual of **SASS v.2.1**, the Spreadsheet Anthropometric Scaling System (version 2.1).

It describes the usage of **SASS**, a spreadsheet-like system which allows flexible interactive access to all anthropometric variables needed to size a computer-based human figure, described structurally by a **PEABODY** file.

Data that may be accessed is organized into the following "groups": segment dimension ("girth"), joint limits, center of mass, and strength, all of which work based on statistical population data. **SASS** creates generic computer-based human figures based on this data.

**SASS** also is an anthropometric database and interactive query system that works upon anthropometric data of real individuals. Scaled computer-based human figures created by **SASS** can be displayed directly, and interactively changed, within the *Jack* software.

# 1 Introduction

## 1.1 Using This Manual

Welcome to **SASS v.2.1**, the anthropometric spreadsheet and database. If you are already familiar with the program from an earlier version, you should go now and try the tutorial in Chapter 2, which includes the main functions now available in the program. You should then consult Chapter 3 if you need further information on a particular topic (check the table of contents at the end of this manual).

The rest of this chapter (Chapter 1) introduces you to the program, tells you how to install the program, and about the notational conventions used throughout this document.

Chapter 2 is a quick introduction to **SASS**, arranged somewhat like a tutorial. If you wish to use the program casually, this chapter will probably contain all the information you need. The final section of the tutorial is very different, and is a sort of advanced tutorial for people who do not like tutorials.

Chapter 3 is a complete reference guide to the features of **SASS**. It is not a pure reference guide, as some extra examples and explanation appear with the more complicated commands. The table of contents and appendix may help you to find things. This reference manual is intended to be complete, and all the features of **SASS** should be documented.

Chapter 4 is a short collection of “tricks” that have proven to be very useful for some **SASS** users.

The Appendix contains a table of hot-key mappings for all the keyboard keys. Also, a summary table of pull-down menu functions is presented. Also in there you can find the format of the database files. Finally, there is a topic-oriented table of contents at the very end.

Note: All the figures of this document can be found in the last pages.

## 1.2 For Experienced Users

If you know what a mouse is and how to work with a spreadsheet, section 1.3 tells you how to install the program, then try reading section 1.4, run **SASS**, and try to figure out how it works.

There are a few non-obvious, powerful commands, and there is a final section of the tutorial (see 2.5) that is written for people who do not find reading manuals very amusing. Give it a try, and you’ll probably be well on your way to becoming a **SASS** expert.

Also note that at the very end of the appendix there is a special table of contents that is organized by command function for easy access to the reference manual.

**SASS** (Spreadsheet Anthropometry Scaling System) is a very fast mouse-based anthropometric spreadsheet and database to run on Silicon Graphics com-



puters. It is most useful for scaling peabody figure definitions for *Jack*<sup>1</sup>.

The main features of **SASS v.2.1** include:

- Easy to learn.
- Power tool for power users.
- On-line help facility.
- More hot keys for fast access.
- Mouse-based improved interface.
- Up to date with Peabody human figure definition in *Jack*.
- Fully redefinable input and output configurations.
- Object Oriented figure definition.
- Smart body scaling.
- New improved anthropometric database facility.
- New interactive connection with *Jack*.
- Population and individual based models available.

Given the large number of data items needed for anthropometric body sizing, a spreadsheet-like format was a natural choice for the user interface.

**SASS** was originally developed with one idea in mind, i.e., generating the dimensions of each segment of a human figure based upon population data supplied as input. The human model used by the current version of **SASS** consists of thirty one segments (body structures), of which twenty four have a geometrical representation. For each of those twenty four segments, there are three dimensions which are required, namely, length, width, and thickness. This means that at least these seventy-two measurements should be available. **SASS** is distributed with default data, for you convenience.

The psurf (polygon surface) geometry of each segment must be scaled by real measurements for a person or percentile measurements for some specifiable population. **SASS** generates figure files with the appropriate description of the segment dimensions and joint limits, so that *Jack* can display the resulting figure.

**SASS** uses population statistic data to create generic human figures. Alternately, **SASS** has a built-in anthropometric database that stores anthropometric data for (real) individuals and provides an interactive query system for database access.

---

<sup>1</sup>JACK is a trademark of University of Pennsylvania

**SASS** allows flexible interactive access to all variables needed to size a human figure described structurally by a Peabody body file. **SASS** screens, as shown in Fig. 1 and more diagrammatically in Fig. 2, are divided into different sections including anthropometric group selection, global data, command menu, local data.

Data that may be accessed is organized into anthropometric “groups”. The current version handles four groups: segment girth, joint limits, segment center of mass, strength.

The global data section of the spreadsheet is intended to allow a “whole body” view of the current figure parameters. Currently the items considered are: **population**, **sex**, **figure type**, **mass**, **stature**, and **overall percentile** of any human figure. It is important to realize that since **SASS** is a relational spreadsheet, modifying any data in this section will affect the values of the individual segments. For example, changing the figure’s percentile will cause the data to be scaled in other appropriate segments contributing to stature.

The data section is used for the display of individual segment data and their corresponding percentiles. The leftmost column is reserved for the segment names, while the other six columns are used for the data and percentile display. The segment name column cannot be modified, but the figure definition file can be customized if needed (more on this later). The data is read in from a selected population input file.

Data and its corresponding percentile is modified by simply moving the locator device to the desired cell and pressing on a button. Changing any segment percentile will change its corresponding dimension. **SASS** keeps a current measurement unit type for each group (**in**, **cm**, **deg**, **rad**). Unit conversion is performed when necessary.

All **SASS** functions are accessed through pop-up menus, direct spreadsheet cell manipulations, or through the hot keys. In the case of database queries, you request the desired information through pop-up menus and **SASS** translates it into the actual query recognized by the database system. The query results are displayed in the spreadsheet format.

**SASS** is written entirely in C/C++, and makes use of UNIX system calls, calls to the Silicon Graphics graphics library (the GL).

To invoke **SASS** from the shell, you simply type **sass**. In this document, however, we refer to it as **SASS** (i.e., uppercase).

**SASS** was written by Francisco Azuola. The database facility was written by Teo Kok Hoon.

All the bugs are due to Francisco. Please send him any bug reports or suggestions (azuola@graphics.cis.upenn.edu).

### 1.3 Installing the Program

**SASS** program is distributed in the form of an executable file, and several data directories.

The executable file is: **sass**.

To execute **SASS**, you need to type **sass** at the UNIX prompt. The executable has been compiled to be used under IRIX 4.0 and above. The current version of the program is 2.1.

The executable, **sass**, is put in **/usr/bin**. The data is in **/sass/data**.

You must have the following directory label in your environment (**.tschrc** file).

```
SASS_DIR = /sass/data
```

pointing to where all the data files are, i.e., files with extensions:

(**xx.dat**, **xx.fig**, **xx.db**, **xx.lbc**, **xx.ntc**, **xx.ffc**).

The **SASS** directories are:

- **data/**: Contains default data files used by **SASS**. In principle, all these files could be modified, but we recommend not to do so unless you know what you are doing.

In this directory, there are four main groups of files:

- \*.fig files
- \*.db files
- \*.dat files
- \*.ffc files

The \*.fig files are **pconthum.fig** and **cconthum.fig**, and they are used as control figure files. These two files are parsed by **SASS** to know the details of the output file it is expected to produce. In a sense, one can think of **SASS** as a compiler of *Jack's* figure description files. As output, another figure file is generated with the same structure as **pconthum.fig** (if polybody figure is created) or **cconthum.fig** (if contour figure is created), but containing the appropriate values.

The \*.db files are files associated with the database. These files contain data from real people, gathered by NASA [**Pandya 92a, 92b**].

The \*.dat files are divided into 4 categories:

- **girth.dat**, **jntlmt.dat**, **cmass.dat**, **napgth.dat**. The first 3 files correspond to the spreadsheets' default values. The files **girth.dat**, and **napgth.dat**, (and **ngfgth.dat** which is a copy of **girth.dat**), correspond all to girth information.<sup>2</sup> **jntlmt.dat** and **cmass.dat** contain the joint limits data and the center of mass data<sup>3</sup>.

---

<sup>2</sup>Girth Data corresponds to Army 1988 Anthropometry Survey [**Natick 88**]

<sup>3</sup>This data has been taken from NASA-STD-3000, Man-Systems Integration Standards [**NASA 87**]

- `*trans.dat` and `*scale.dat` are files used by **SASS** to scale the figure files it produces. They have been produced by applying **SASS** to the control `*.fig` files above.
- `xref.dat` is a cross reference file containing a listing of the joints in the control figure files and the corresponding joint limits values available in **SASS**, if any. `_void` is used to signal that **SASS** doesn't support a particular joint, and thus, **SASS** only copies the joint values verbatim from the control figure files.
- `_s_fig_def_*.dat` are files containing a figure description file to be parsed by **SASS** at the beginning of any session. These files contain the necessary information for **SASS** to create the data structures it needs. These files are given to you as default, but can be changed if necessary. However, if you decide, to do so, make sure you understand the mechanics of **SASS** internal operation.

The `*.ffc` files are files associated with the strength sheet. These files have been provided by NASA <sup>4</sup>. Programs by NASA for manipulating the aforementioned data were adapted into **SASS** as well.

- `doc/` : This directory contains **SASS** documentation. `sass.tex` is the text under Latex formatting, and `sass.ps` is the postscript version. The other files are just auxiliary and figure files.

Since you're reading this reference manual, you probably don't need it, but it's likely that the  $\text{\LaTeX}$  source for this manual (called `sass.tex`) can be found somewhere.

## 1.4 Notational Conventions

You can do most of your work using just the mouse, but your working efficiency will improve dramatically if you use hot-key combinations for some of the more common commands, once you know your way around. The **SASS** hot-key commands are produced by holding down specific keyboard keys. *Hot keys.*

When `<Shift>` is required as part of a command specification as in `<?>`, you must hold that key down, i.e., `<Shift> <?>`. The key marked `<Enter>` on the keyboard allows to complete a data input.

*Clicking* a mouse button refers to a quick press and release of a mouse button without moving the mouse. Typically, the left mouse button is used to select commands or to select a specific sheet cell for input. The right mouse button is used with pull down menus.

In this document, file names, commands that might be typed to the UNIX shell, used to illustrate some **SASS** features are displayed in a **typewriter-like font** (like this).

---

<sup>4</sup> All strength information is according to [Pandya 92a, 92b]

Certain commands in **SASS** can be invoked in different ways. When this is the case, a command name is often used rather than the specific key to indicate that any method for invoking that command yields the same result. Command names appear in a bold version of the standard Roman font, and are typically capitalized, for example: **Create Fig**.

A particular key is denoted within  $\langle . \rangle$  (e.g.,  $\langle \mathbf{m} \rangle$ ). When a mouse button that must be clicked is involved, it is denoted within  $[.]$  (e.g.,  $[\mathbf{OK}]$ ).

## 2 A Short SASS Tutorial

The tutorial assumes that this is the first time you are using **SASS**.

### 2.1 Starting the Program

To run **SASS** on one of the Silicon Graphics Iris 4D workstations, type **sass** after the shell prompt: *Running SASS.*

```
% sass
```

It takes a few seconds for the program to initialize. If you've never used a mouse-based spreadsheet before, skip to the next paragraph; otherwise, you can probably figure out a lot right now by just playing around. After you're comfortable, try out the last section of Chapter 2 — it's an advanced tutorial for people who normally hate tutorials. The left mouse button does almost everything. It does selection, and runs the scroll bar. The right mouse is used to select items from the pull down menus. Hot keys are gotten by holding specific character keys. If things go pretty well, you may want to skip to the last section of this tutorial or scan the section headings in the table of contents to figure out what sorts of things **SASS** can do.

After you typed **sass** and pressed <Enter>, parsing of the scripts (figure definition files) and reading of population data will take place and a grid or frame will then appear on your screen. Moving the mouse, center the grid to the desired position on the screen, and then press any mouse button. After a few seconds, the anthropometric spreadsheet will appear on screen. The spreadsheet is filled with numbers, corresponding to the default data. See section ( 1.3).

At the bottom of the spreadsheet is the **Dialog Line** which is used for displaying any messages about what **SASS** is doing and in certain cases to input data from the user. The first message that should appear in this line is: *Dialog Line.*

Press LEFT Mouse Button to select items.

Different operations and commands on the data in the spreadsheet may now be performed.

If you need to select a cell, you must use the left mouse button. Use the mouse to move the cursor to the cell of interest, and press the left mouse button down. Notice how the selected cell is highlighted, even before you release the mouse. The highlighting before the cursor release indicates what will be selected if you release the mouse button at that point (the highlight color is black). *Selecting cells.*

Selecting a cell does nothing to it. If you make a mistake and select the wrong cell, or change your mind, just press <Enter> key or click the [OK] button.

If you want to experiment a bit, try clicking and changing the cell values. Using the Dialog Box is simple. To move the cursor, use the arrow keys, or point with the mouse. To erase (part of) the current number drag the mouse on top of it with the left button pressed. This should highlight the number. *Using the Dialog Box.*

Press the <Delete> or the <Backspace> on your keyboard. An easier way is to press <ESC>. This will clear up the Dialog Box entry.

There are two types of spreadsheets. One is the *Anthropometric Spreadsheet* which is used to display the anthropometric data for a population based person in different anthropometric groups. This spreadsheet allows you to browse and modify any anthropometric data. The other type of spreadsheet is the *Database Query Spreadsheet*. This spreadsheet is used to build queries for the anthropometric database and to display the results of the queries. This database works with data from particular individuals. Each of these spreadsheets is described in the reference chapter. *Spreadsheet types.*

## 2.2 Scrolling

Since the amount of items on the screen usually is longer than the **SASS** window size you can scroll through the rest of the items using the left mouse button in the scroll bar to the right upper corner of the sheet. In the database, use <p> and <n> to move across sheets horizontally, and use the funny looking buttons (concentric rectangles) in the upper right corner to move between pages vertically. For the strength spreadsheet the upper funny looking button to move between pages.

## 2.3 Creating output files

By now, you've probably trashed the sheet cells pretty well, but pretend for a minute that the modifications you've made were useful, and that you'd like to use this information to create a figure file, or a scaling file, to be used on an existing figure.

Select **Create Fig** entry, in the command pad (upper right corner). If you use this command button, you will be asked for the type of file you want, that is, a plain [s]caling file or a full [f]igure file. Try [f]igure and follow the instructions given to you. You must provide a "valid" name for the file. This file will be created and saved in the directory under which **SASS** was invoked, or you can use the dialog box to indicate a new directory. You can use *Jack* to display the figure you've created.

## 2.4 Saving the spreadsheet contents and Quitting

After a joyful time working with **SASS**, you are ready to quit the program. But what about all those nice numbers you have stuffed in? Well, you probably don't care too much about them. After all, you were just "playing" a bit with the program. However, pretend again that the modifications you've made were useful. In order to save the spreadsheet contents type <S> or select the menu item [Save sheet] (click the lower funny looking button in the upper right hand corner of the sheet to reach the menu). However since right now you also want

to exit the program, press [Quit]. Click [Yes]. Then click [Yes] again to save the spreadsheet contents in a file. Now you must provide a valid name. You need not to worry about the “.sas” extension, which is appended automatically by the program to the name you provide.

## 2.5 Advanced Tutorial

If you pretty much know what you’re doing, try out some of the commands in this section. Just do what it says, and you’ll be introduced to some of the powerful things that **SASS v.2.1** can do. Play around, and you’ll probably understand the commands well enough to use them yourself. If not, complete details are available later on in this reference manual. For your convenience, the appropriate reference section appears following each entry in parentheses. Also notice the margin titles telling you the purpose of each exercise.

Here are some exercises you might like to try:

*Help.*

1. (3.1.12) Press <?> (do not forget that this is a shifted key) to activate the help sheet. Press any key to go back to the main sheet. Press <H> (don’t forget shift key). This will bring up the help menu. This is a more extensive help. Select one of the topics in the pull-down menu by dragging the mouse while pressing its right button and releasing it when you are on top of the specific item. A rubber band window will appear on screen (basically its frame). You must press the right mouse button and drag the mouse simultaneously to make it big enough for you to read its contents.
2. (3.1.3) Select any cell in the middle sheet, i.e., a value cell. This is done by dragging the mouse with the left button pressed to the particular cell, and then releasing it. The cell will be highlighted. The Dialog Box should be on screen. Enter any number and press [OK]. Observe the changes.
3. (3.1.2) Press the <f> key or click in the [male] cell in the header of the sheet. This will switch the gender. Press then <m> or click the [female] cell to go back to the male case.
4. (3.3.1) To change body model, press the <n> key or click the [polybody] cell in the header of the sheet. This will switch the figure model. Press then <p> or click the [contour] cell to go back to the polybody case.
5. (3.1.1) To activate other groups, press <j> or click the [Joint Limits] cell (in the top line of the sheet). This will activate the Joint Limits Group sheet. Press <c> or click [Center of mass]. This will activate the Center of mass Group sheet. Press <t> or click [Strength] to proceed to the Strength Group sheet. Press <g> or click the [Girth] cell to go back to the Girth Group sheet.

*Cell Selection.*

*Gender Selection.*

*Body Model Select.*

*Selecting Group.*

*Scrolling.*



6. (3.1.10) First, make sure you are in the girth group spreadsheet. Pressing <g> will take you there. Press <s> to activate the segment mode display. The scroll bar will appear in the upper right corner of the sheet (gray color). Use the mouse to select this bar (use the left mouse button) and drag it up. Release at some point the mouse button. The sheet will now show more segments from the list of segments, hiding some others from the beginning of the list. Click the left mouse button on the scroll bar to go back to normal display.
7. (3.1.13) Press <s> or the top “funny looking” button in the right corner of the sheet to activate the segment - object selection display. Press [segment]. Try again, but now press [object]. Segments and objects are closely related, as the objects (or body parts) are composed of segments.
8. (6.3) Press lower “funny looking” button in the right corner of the sheet to activate the pull-down menu. When the menu shows on screen, do not forget to use the right mouse button to select an item. Try selecting the item “male” from the “Figure” drawer of the menu (leftmost drawer).
9. (3.1.2) Try modifying the group percentile cell. By default its value is 50 percentile. To do so click the [Group Percentile] cell in the sheet header, and input another value.
10. (3.1.4) Change units by clicking the [cm -> in] button on the command pad of the sheet. Go back to cm by clicking [in -> cm].
11. (3.4) We will use the query sheet to find the following subsets of individuals:
  - Those who are heavier than 65kg and have zero fatigue level
    - Click on the **Query DB** button to begin. Click the right mouse button to bring up the **Query Menu** and select **Global Information**. Use the right mouse button again to select **Mass** and again to select the > operator. When the “Type in value:” prompt appears in the dialog line, type 65 <enter>. Click on right mouse button now for the **Conjunction Menu**, select the **and** operator. Repeat the process of clicking on the right mouse button to select **Global Information**, **fatigue**, **Level 0** and finally **Done**. You will see the query string “mass > 65 and fatigue = 0” incrementally form as the query is being constructed. At any point of time, you can select the **Previous Menu** item to redo a selection. Note that the **Abort** command is available only in the **Query Menu** and the **Conjunction Menu**.
  - The list of people found in the previous query (“those who are heavier than 65kg and ...”) who have a percentage of lean mass greater than 80

*Selecting Segments-Objects.*

*Function Menu.*

*Group Percentile.*

*Units.*

*Query Sheet.*

- Assuming that you have successfully executed the previous query, click on the [**Extend Qry**] button in the command box. Now, right mouse button would bring up the **Conjunction Menu**. Continue to build the query by selecting **and** followed by **Global Information, % Lean Mass, >**, type *80* <enter> and select **Done** to execute.
- Those people found in the second most recent query
  - This can be done easily by invoking the query history dialog by clicking on the **Qry History** button. A dialog box containing a scrollable list of the 50 most recent executed queries pops up. The first row refers to the current query, the second refers to the previous query and so on, click on the third row followed by the [**Ok!**] button.
- The bottom 5 people of the currently displayed list.
  - Click on the [**Select**] button, all names will be highlighted. Now click on the middle mouse button, all names will be un-highlighted. Click on the bottom 5 individuals using the left mouse button to bring back the highlight. When ready, click on the right mouse button to commit the selection. All individuals whose names are not highlighted will be discarded from the current list.
- People taller than 175 (cm) and who has shoulder flexion strength greater than 30 (ft-lbs) and knee extension strength greater than 40 (ft-lbs)
  - Begin this query by clicking on the **Query DB** command once again. Select in order, **Global Information, stature, >**, *175* <enter>, **And, Anthropometric Groups, strength, shoulder**, type in the required shoulder velocity and angle, select **flexion, >**, *30* <enter>, **and, Anthropometric Groups, strength, knee**, type in the required knee velocity, angle, continue to select **extension, >**, *40* <enter>, **Done**.
  - Notice that in our previous example, there are more attributes than can be displayed. The rest of the attributes can be seen by using the horizontal scrolling keys, namely <n> and <p>. <n> scrolls to the next horizontal section if there is any while <p> scrolls to the one before. The **Project** button can be used to filter out unimportant attributes. Click on the **Project** button now to highlight all the currently displayed attribute labels. Remove the *C1*, *C2* and *C3* shoulder strength equation coefficients by clicking over them using the left mouse button. Middle mouse button can be used to reverse the status of all attribute labels. Click on the right mouse button to commit the changes. Notice

that more attributes are shifted into the columns made available by *C1*, *C2* and *C3*.

- Now that we have the list of individuals we want, we can create figure files for each of them by clicking on the **Create Figs** button. You need not to supply a filename for each of the individuals you see listed, as the program will automatically provide names for you, unless you want to give the figures special names. At any point of time, click on **Cancel** to discontinue the operation.
- Select [Exit Query] button to exit the DB. This will take you back to the spreadsheet mode.

*Strength Group.*

12. (3.2) Press <t> or click on [Strength] with the mouse from the group menu line (at the top of the sheet). The strength sheet is a bit different from the other spreadsheets. The values you see on screen correspond to angles in the diagonal, and to strength values in the last column. If you modify an angle value, in the diagonal, the corresponding strength is computed. Try modifying any of the angles. Notice that the angle you input could be clipped if its value is beyond the particular joint angle limits (the joint limits used are those found in the joint limits sheet). Try changing pages, by pressing the upper funny looking button in the top right of the sheet. Also, try changing the strength mode (currently possible only in the first page of the strength sheet). There are two possible modes, predict and individual. Try modifying the motion speed field. To do so, click in the “motion speed” value cell, and enter a number at the dialog box. The range of speed goes from 60 to 240 deg/s, and is 60.0 deg/s by default. Values outside those limits will be clipped. Finally, try modifying the lean body factor field (10.4% by default). To do so click in the “lb factor” value cell, and enter a new value.

*Figure File.*

13. (3.1.4) This is population based figure creation. Click on the [Create Fig] button and click [figure], or just press the <b> to select the figure option. You will also be asked for the type of figure you want, namely, polybody or contour. Choose polybody by clicking on it. The Dialog box will ask you then for a file name. Type in a name, say, “test.fig”. The .fig extension is optional. The creation process takes a few seconds.

*Sass-Jack Interface.*

14. (3.3) This exercise will enable you to do interactive use of **SASS** with *Jack*. You must go into *Jack* and set up an environment containing (at least) a human figure. Basically, load the file “test.fig” that you created in the last exercise. Then in *Jack* you must select the **SASS** command. This will make *Jack* enter a wait mode. Then go to **SASS**. Change the group percentile (see above) to 75% and press <w>. A figure name is requested. If the environment in *Jack* contains only one figure, press <Ok> (this is our

case). Otherwise specify the name of the figure to be scaled (in our case the name would be “test”). A direct communication with *Jack*, in which **SASS** sends scaling commands to *Jack*, will then take place. Once it is done, you must repeat this process to do another connection. However, if you want to browse among the possible percentiles available, you can set up *Jack* into the waiting mode, and then press <r>, making **SASS** enter a repeated transmission mode. It will repeatedly ask you for a new height percentile value and transmit the corresponding scaling commands to *Jack*. Press <Enter> or click <OK>, without entering a new value, to finish the connection with *Jack*.

*Scaling File.*

15. (3.3.1) More output creation. Click on [Create Fig] button and click <scale>, or just press the <k> to select the scaling option. You will be prompted for a figure type. Choose [Polybody] by clicking on its button. Now, the Dialog Box will ask you for a file name. Type in a name, say, “test.jcl”. The .jcl extension is optional, since the program will put it anyway if you omit it. The Dialog Box will ask you for a figure name. At this point it is not important to come up with a meaningful name. Just press [Ok].

*Stature model.*

16. (3.1.13) Press <d> <v>. This will select the dynamic stature model. Press <d> <s>. This will select the static stature model. For now you need not to worry what this commands do.

*Stature percentile value.*

17. (3.6.3) Try modifying the stature percentile cell value. Select that cell by clicking with the left mouse button. The Dialog box will prompt you for a new value. Input a value, say 75%.

*Saving sheets.*

18. (3.1.15) The contents of the spreadsheet can be saved into a file. To do so, press <S> or click [Save sheet] in the pull-down menu (which is activated by clicking at the lower funny looking button in the upper right corner of the sheet). A Dialog Window appears asking you for a file name. Type in a name, say, “test.sas”. The .sas extension is optional. A file will be created to register the contents of the spreadsheet. The database saves query history automatically, so you need not to worry about it.

*Clearing Sheets.*

19. (3.1.16) Now clean the spreadsheet current contents by pressing <G>, which “cleans” up all the sheets for all the group types, or pressing <L>, which only cleans the sheets associated with current group (i.e. girth, joint limits, or center of mass).

*Reading sheets.*

20. (3.1.14) Now try reading the previous contents of the spreadsheet stored in the file “test.sas”. To do so, press <R> or click [Read file] in the pull-down menu. A Dialog Window appears asking you for a file name. Type in “test.sas”. The .sas extension is optional.

*Quitting.*

21. (3.5) To quit the program you either select the [Quit] button from the command panel, or press <Q>.

## 3 SASS Reference Manual

This chapter is a more or less complete reference manual for **SASS**. It's probably a bit painful to read, since it goes into detail about each command. Your best bet for using it is to scan through the table of contents, or better still, through the "Contents by Topic" section at the end of this manual, and read about only those features that interest you. Some attempt may be made to increase the size and quality of this section in future versions of the documentation.

### 3.1 Anthropometric Spreadsheet

The anthropometric spreadsheet screen is divided into five main sections: anthropometric group status, global data, command menu, data section, and Dialog line. Each of these screen sections is described below.

#### 3.1.1 Anthropometric Group Status

The present version handles four groups: girth, joint limits, center of mass, and strength. When a group has been selected, the color of the group's cell will be changed, and the desired group data file will be loaded and then displayed in the data section. The function to load in any desired group file will be explained in the **Command Menu** section.

*Groups.*

#### 3.1.2 Global Data

This section of the spreadsheet is used to display the "summary" of the data being displayed. It is intended to allow you to have a "global" view of the human figure that you are working on. Currently, the eleven labels are: *population, figure type, gender, mass, stature, group percentile, strength type, motion speed, strength mode, lean body factor, and fatigue level*. Some of the labels are activated at the click of the mouse. When this is the case we will refer to such a cell as "being active". A group percentile indicates the percentile of each anthropometric group. Changing the group percentile will cause the data for all segments, body parts, or joints of the displayed group to be scaled to the newly specified percentile value. However, it will not change percentiles for the other groups. The group percentile will allow you to create a human figure with different percentiles in different anthropometric groups if desired.

You cannot modify the label of the currently displayed population, because it is read from an input file. This label is used to indicate the current population data file that you have selected. However, you can choose the Input Data option to load another population file. The definitions of other fields in the **Global** section are summarized as follows.

*Global Section.*

- **Figure Type**

This indicates the type of human figure model which you want to create

using the *Jack* interface after exiting **SASS**. Currently, there are two human figure models, *contour* and *polybody*, which can be selected in **SASS**. This cell is active.

- **Gender, Mass, and Stature**

These indicate the respective current values of the human figure (defaults are male with 50<sup>th</sup> percentile mass and 50<sup>th</sup> percentile stature). Gender and stature fields are active, and so they can be modified to fit your needs. Mass fields are dependent on stature, so you can only modify them indirectly through stature modification.

- **Strength Type, Motion Speed, Strength Mode, lean body factor, and Fatigue Level**

These parameters are related with strength computation [Pandya 92b]. Motion Speed, Strength Mode, and Lean Body factor are active fields.

### 3.1.3 Data Section

This section contains the data for each of the items included in the body description model.

The data section for girth, and center of mass is reserved for the display of body parts (objects) or individual segment or joint data for the corresponding percentiles. The leftmost column is reserved for the body part of segment, joint, and object names, while the other six columns are used for the data and percentile display. The segment, object joint name column can be modified by editing the figure files “\_s\_fig\_def\_xx.dat” which contain a description of **SASS** human body model. \_s\_fig\_def\_gx.dat correspond to figure files for male and female girth. \_s\_fig\_def\_cx.dat correspond to figure files for male and female center of mass. Default files are provided for user convenience. If you need to modify any of these files, make a copy of them in your local directory and perform the desired changes. If you run **SASS** from this directory it will read the new version of the files rather than the default one. Make sure you understand what you are doing before modifying these files.

*Data Section.*

Data and its corresponding percentile can be modified by simply moving the mouse to the desired cell and pressing on the left-mouse button. The color of the selected cell is then changed and a new data value for the selected cell can be entered in the Dialog Box. Pressing the <Enter> key or the [OK] button without typing a new data value leaves the cell unchanged. Changing any percentile will change its corresponding value, and vice versa.

*Cell Select.*

### 3.1.4 Command Menu

The top right corner of the display contains commands for the manipulation of the spreadsheet. These commands allow you to go to database query spreadsheet

screen, change the measurement units, read in different input data files, get Help from **SASS**, create **PEABODY** figure files, and Quit the program.

Fig. 3 shows a diagram of the Command Menu.

- **Global Conversion of Measurement Unit**

Depending on the group that one has selected, the conversion units appearing *Units*. on this command will be different. For example, if one is working on the joint limits and the measurement unit is in degrees, then the command will be *deg*  $\longrightarrow$  *rad*. This implies that in the current group, one can only convert the measurement unit from degrees to radians. On the other hand, if the current unit is already in radians, then the command will be *rad*  $\longrightarrow$  *deg*. If one is working on the girth, then the conversion unit will be *centimeters* to/from *inches*, and for joint limits it will be *degrees* to/from *radians*.

- **Input Data**

One of the most important features of this spreadsheet is its ability to display, modify and create generic human figures from different populations. **Input Data** allows you to load different population statistic data files into the spreadsheet. These data files must have a syntax that is recognized by the input functions of the spreadsheet otherwise it will be rejected (see the \*.dat files in **SASS**'s data directory). The default input data files of girth, joint limits, and center of mass are *girth.dat*, *jntlmt.dat*, *cmass.dat*, respectively.

- **Create Figure**

After specifying the girth, joint limits, and center of mass of a human figure, it can be built and displayed. The command **Create Figure** will create a **PEABODY** figure file that is recognized by *Jack*. Once this file is created, we can go into *Jack* and display the newly created figure file. Once **Create Figure** is active, click on Figure File. You will be prompted for a file name.

- **Query**

The *Query* command is used for changing spreadsheet screens from the *Anthropometric Scaling* to the *Database Query*. After the *Query* command is executed and the *Database Query* screen is displayed, one can query the database. The details of the *Database Query* spreadsheet will be described later.

- **HELP**

The *HELP* command brings out the extended help pull down menu. Use the rightmost mouse button to select a topic. Then use the mouse to drag the rubber window to a big enough size. If the complete help text fits in the current window, no scroll is necessary. Otherwise use the scroll bar to display more text. Pressing <Exit> the help window disappears.



### 3.1.5 SASS Hot Keys

Hot keys have been provided for your convenience. Hot keys are an alternative *Hot keys.* to the mouse oriented selection of commands.

The following is a description of the hot keys:

- <dv> Select dynamic stature model.
- <ds> Select static stature model.
- <o> Select object model.
- <s> Select segment model.
- <g> Select girth group.
- <j> Select joint group.
- <c> Select center of mass group.
- <t> Select strength sheet.
- <n> Select contour model.
- <p> Select polybody model.
- <m> Select male sheet.
- <f> Select female sheet.
- <b> Create figure file.
- <k> Create scaling file.
- <w> Write to local port (single event)
- <r> Write to local port (multiple event)
- <V> Change Strength Subject
- <L> Local clean up
- <G> Global clean up
- <R> Read file
- <S> Save contents
- <D> Goto Database
- <Q> Terminator quit.
- <?> Show the help message.

In most cases the Dialog line will show the option selected. If in doubt whether an option is ON or not, do the selection again.

### 3.1.6 SASS Pull Down Menu

The pull-down menu is another way to select commands or access help topics, or build up a query (in the database).

Figure 4 shows the pull-down menu as it would appear on **SASS** window.

In the spreadsheet (girth, joint limits, center of mass), press the lower funny looking button to activate the command pull-down menu and use the right mouse button to select an item from the menu.

The help menu is accessed by clicking the <HELP> button, or by pressing [H].

In the database, click <Query DB> to start the query building mode.

### 3.1.7 Dialog Line

SASS's dialog line is used to display messages or to collect information keyed in by you. It comes in a few different flavors, but the interface is consistent across all of them.

Pure messages appear on the line with the message for a short time, and then disappear. If you miss the message, tough. Such messages are usually informational, or of the sort where you can re-issue the command and re-read the message.

*Informational messages.*

Some message lines display more important information, and remain on the screen until you enter the required information.

Some Dialog lines require some text input (numeric values).

*Input request.*

### 3.1.8 Dialog Box

As the dialog line it comes in a few different flavors, but the interface is more or less consistent across all of them. In a file name Dialog box, you must specify a valid Unix path name. In a numeric Dialog box, you should enter a valid number (i.e., no alpha characters).

*More input request.*

The box is totally mouse-based. Using the Dialog Box is quite simple. To move the cursor, use the arrow keys, or point with the mouse. To erase (part of) the current number drag the mouse on top of it with the left button pressed. This should highlight the number. Press the <Delete> or the <Backspace> on your keyboard. A faster way is to press <ESC>. This will clear up the Dialog Box entry.

If selecting a file, type the name of the file, or click twice in the adjacent window on a specific file name.

Figure 5 shows display of the Dialog Box used for file name input.

### 3.1.9 Resizing the Window

SASS window cannot be resized.

### 3.1.10 Scrolling

Usually, the files you view will have more items than can appear on the screen. For this reason, a scroll bar appears along the right upper edge of your window. Use the mouse to activate the bar. In the database, use <p> and <n> to move across sheets horizontally, and use the funny looking buttons (concentric rectangles) in the upper right corner to move between pages vertically. For the strength spreadsheet use the upper funny looking button to move between pages.

### 3.1.11 Making Selections with the Mouse

To place the cursor in a specific cell, move the arrow cursor with the mouse until it points to the desired cell, and click with the left mouse button. You don't have to be exactly accurate — **SASS** lets you hit anywhere in the cell.

### 3.1.12 On-Line Help

There is on-line summary of the hot keys available through the hot-key `<?>`. At any moment, you may invoke the Help Screen. A summary of the hot keys is displayed on screen. (See 3.1.5 for further details).

Also, there is an extended on-line help that can be accessed by pressing `<H>` (notice this is shifted). A menu of help topics appears. Use the rightmost button to open the drawers of the pull down menu, and select the particular topic you are interested in. A rubber band window appears. You must use the mouse to open it to a fair enough size. If the text for the help window does not fit in the space provided, a scroll bar shows up as well, which must be dragged with the mouse to display more text on the current window. Press `<Exit>` when you are done.

### 3.1.13 SASS Special Modes

The Anthropometric Spreadsheet works under four computational models. The dynamic or the static height models, and the object or segment models.

*Height models.*

- **Dynamic height model.** Under this model, the global field stature varies dynamically as the segment (or object) dimensions in the stature path are modified. A limit is imposed, though, to disallow the possibility of body heights beyond or under that of the population range (see 3.6.3).
- **Static height model.** The global stature is fixed while the segments' (or objects') dimensions in the stature path are adjusted to keep the value of the stature constant (see 3.6.3). If it is not possible to achieve this goal, the stature will vary up to the first closer goal. You may correct this to the desired stature (via the stature field). See section 4.
- **Segment and Object Models.** For the Girth and Center of Mass groups, there are two alternative working models. The segment model displays the information in a segment by segment basis. This is convenient when there is a need to visualize the information for a specific segment of the body. If you want to work at a higher level of abstraction, the object model (default) provides a way of modifying dimensions in a (body) part by part basis (e.g. arm, leg, torso, etc). The spreadsheet will automatically adjust the internal components of each of the (body) objects (see 3.6.4)..

### 3.1.14 Reading a file

To read a spreadsheet contents file (i.e., .sas file) , press <R> or click [Read file] in the pull-down menu. A Dialog Window appears asking you for a file name. Type in a valid name. The .sas extension is optional. Alternatively, click twice in the name of the file you want to select. The only files that can be read by means of this command are those created through the “Save” facility of **SASS**. (See 3.1.15).

### 3.1.15 Saving the spreadsheet contents

The contents of the spreadsheet can be saved into a file. To do so, press <S> or click [Save sheet] in the pull-down menu. A Dialog Window appears asking you for a file name. Type in a valid name. The .sas extension is optional. Alternatively, pick the name of an already existent file, which you want to overwrite. The files created through this command can be read by means of the “Read” facility of **SASS**. (See 3.1.14).

### 3.1.16 Clearing up the sheets

To clear up the spreadsheet current contents press <G>, which “cleans” up all the sheets for all the group types, or press <L>, which only cleans the sheets associated with current group. The default percentile is 50th. The database cannot be cleared, but a new query will bring up a (possibly) new set of results. What can be cleared is the query history. To do so, delete the “.sass-qh” file that you can find in your root directory.

## 3.2 Strength Sheet

Figure 6 shows a sample of the strength sheet display.

The strength sheet compute strength values [Pandya 92b], for a particular set of angles and strength equations.

*Strength modes.*

There are two possible sources for strength equations:

- INDIVIDUAL, which are equations based on a particular person’s measurements
- PREDICT, which are equations that consider a population of individuals.

To select between modes, press the lower funny looking button at the top right of the sheet. To move across pages use the upper funny looking button.

These equations vary depending on the velocity, for INDIVIDUAL case, and on the velocity, weight, lean body factor, for the PREDICT case.

The PREDICT case generates new equations on the fly, based on the current weight, lean body factor, and velocity.

The INDIVIDUAL case uses a fixed set of equations, of a given person, but the equations chosen depend on the current velocity. By default, the individual selected is “sub01”. To change subject, press <V> and provide the name of the new subject.

*Strength parameters.*

When you create a figure, the current strength equations are appended to the figure file. A few things must be noticed. Currently, PREDICT equations consider only the upper body joints. So the lower body joints can be displayed only in INDIVIDUAL mode. Also, when creating a figure, you must go into the mode whose equations you wish to be included in the figure, i.e., INDIVIDUAL or PREDICT. This change of mode can only be done while in the strength sheet. Finally, the strength equations for the lower body joints are included in the figure only if the figure is created while being in the lower body joints section (last page) of the strength sheet.

*Strength in figure.*

### 3.3 SASS-Jack Interface

**SASS v.2.1** can interact with *Jack* in an interactive way. Given a human figure in a particular *Jack* environment, **SASS** can be used to interactively scale this figure. To accomplish this a communication socket is established between **SASS** and *Jack*.

*Port SASS-JACK.*

The protocol to be followed is described next. In *Jack*, an environment containing (at least) a human figure must be set up. Then **SASS** command in *Jack* must be executed. This will make *Jack* enter a wait mode. In **SASS**, a specific scaling (i.e., the desired girth values) must be defined, or else the default ones will be used. Then <w> must be pressed. The name of the human figure to be scaled is requested. This is only for the case of having multiple figures within the environment.

Once the port is opened, **SASS** sends scaling commands to *Jack*. When it is done, the process must be repeated if another transmission is desired.

*Single scaling.*

An alternative to individual scaling transmissions is the REPEATED scaling mode. This mode is useful if one needs to browse among the possible height percentiles available, to decide which one fits the best in a particular environment. The protocol for this is as follows. *Jack* must be set into the waiting mode, and then in **SASS** <r> must be pressed, to make the program enter the desired repeated scaling mode. Once in this mode, the program will repeatedly request percentile values. For each of the values provided, a new scaling is applied to the human figure displayed in *Jack*. When the desired percentile is found, press <Enter> or click <Ok>, without introducing any new value. This will break apart the connection.

*Repeated scaling.*

#### 3.3.1 Figure Scaling

The reason you should consider using direct port communication with *Jack* rather than loading figure files is simple. Consider the situation in which you,

working with *Jack*, want to determine the percentile (dimension) ranges of the human figure to comply with a given task, that is, the problem of finding the specific figure (%) that can fit in a particular working environment. One can attempt to read each of the possible figure files out of *Jack* libraries and try to keep the figure in the position we want. The other (more sensible) option is not to load different figure files, but instead, to apply different scalings to a given figure. Then the (same) figure can be scaled using different scalings to find the one that best suits the given environment. This is not only faster but it is even more appealing to you, as you can see the changes right away on screen.

### 3.3.2 Figure Creation

Figures 7 and 8 shows display in *Jack* of figures created in **SASS**.

Why use figure files rather than scale files? Scaling files are good when you require easy access to multiple sizes for the same figure. If, on the other hand, you need multiple figures of different sizes then figure files should be used. Also, figure files are a precise image of **SASS**'s segment / object dimensions, while the scaling file is a global approximation of the body parts, i.e., the body is scaled by *Jack* based on the global (body part) scaling values defined by **SASS**.

As a better alternative to scaling files, you can use the port option (see sections 3.3 and 3.3.1) to interactively scale an already existent figure in *Jack*. This is perhaps the most useful way of finding the right scaling for a body within a given environment.

To do figure creation, click [**Create Fig**]. Then click on [**figure**] and specify the type of figure you wish to create, namely, polybody or contour. Then you must specify the file name. The extension ".fig" is optional.

If you are in the database sheet, the procedure is similar, but you will be asked additionally to provide velocity values for some joints. If you don't care for this option (only if strength computation is relevant), just click [**OK**]. Otherwise, provide the desired values.

To create scaling files, click on [Create Fig] button and click <scale>, or just press the <k> to select the scaling option. You will be prompted also for the type of figure you wish to create. The Dialog box will ask you for a file name. The .jcl extension is optional, since the program will put it anyway if you omit it. The Dialog Box will ask you for a figure name. This should be the name of the figure you intend to apply the scaling to. Just press [**Ok**].

## 3.4 Database Query Spreadsheet

This spreadsheet is used to build a query and display the result of the query. As shown in Figure 9, this spreadsheet is divided into five sections: summary data, command menu, scroll buttons, query list, and Dialog Line. Each of these sections is described below.

Figure 10 shows a sample of the query sheet display.

### 3.4.1 Summary Data Section

This section displays the query requested by you under the label “Query”. The typical query is to find the list of individuals who satisfy certain constraints on global or local anthropometric data. Example queries are: “find a person who has a right upper arm longer than 28 centimeters” or “list any right handed females who have elbow flexion strength greater than 20 ft-lbs.” The summary data section also displays the summary of the result of the requested query. The label *QUERY:* shows the last query executed. It is a scrollable line, for there may be queries that are longer than the space provided. To scroll the query line to the right, click the left mouse button on the red < character beneath the query line. The red > has the opposite effect, i.e., scroll back. The label *Current Display Page* indicates the currently displayed page and the total number of pages available for vertical scrolling. *Current Display Section* indicates the currently displayed section and the total number of sections available for horizontal scrolling. *Total Data in Query List*, indicates the total length of the list currently displayed in the *Query list* section.

*Query Database.*

*Query list.*

### 3.4.2 Query List Section

This section displays the list of individuals that satisfy the requested query. The leftmost column shows the ID number and the name of an individual while the subsequent columns show the set of related attributes found in the query. For example, a query such as “find all persons with mass  $\geq 65\text{kg}$ ” would display the mass attribute as well as global information like gender, stature, handedness, and age. Each row contains the relevant information of an individual.

### 3.4.3 Scroll Buttons

These are used for paging purposes in the *Query List* section. Click on the upper button to scroll to the previous page, or the lower button to the next. For the purpose of horizontal scrolling, use <n> to get to the next section and <p> to return to the previous.

### 3.4.4 Command Menu

As in the *Anthropometric* spreadsheet, the top right corner of the database query display contains commands for the manipulation of the spreadsheet. These commands allow you to further restrict the amount of information displayed in the *Query List* section as well as the list of individuals found in the current query. The present **Command Menu** section of *Database Query Spreadsheet* is shown in Figure 11. The function of each of these commands is described below.

The following relations are implemented in the current version of **SASS**. The attributes (fields) of each relation are listed under the corresponding relation together with brief comments. For example, *Girth* relation contains the data of

*Relations.*  
*Attributes.*

thickness, width, length, and mass of each segment in the body for an individual (person). It includes attributes of *id\_num*, *seg\_name*, *thickness*, *width*, *length*, and *mass*. *Id\_num* is an identification number used to identify an individual uniquely. Every relation in the database has this attribute. It allows us to link two relations together and find all the data stored in the database for an individual if desired.

Each relation is stored as a “flat” file in fixed format. The order of the fields “must” follow the one in the corresponding relation. See appendix for more details on files format.

The default data is stored in the files *person.db*, *girth.db*, *jntlmt.db*, *cmass.db*, *strgth\_param.db*

The strength data files are stored in the \$SASS\_DIR directory. Note that each subject has a subdirectory within \$SASS\_DIR.

- **Project**

*Project* allows you to remove some of the attributes(columns) in the *Query List* section. This command comes in handy when you need to juxtapose a selected number of attributes which are displayed in separate sections for comparison purpose. Clicking on this command button causes the currently displayed attribute labels to be highlighted. Click on an attribute label to toggle the highlight, all attributes which are not highlighted will be subjected to removal. Middle mouse button reverses the status of each attribute, right mouse button removes all attributes which are not highlighted.

- **Select**

The *Select* command operates in a similar fashion as *Project*. It allows an on-screen selection or removal of individuals(rows) from the *Query List* section.

- **Query DB (Query Database)**

This command allows you to make a query request and get the answer back from the database. After you select *Query DB* from the **Command Menu** section, the following message will show on the **Dialog** line:

Building Query:

This indicates that you can press the right-mouse button to build a query from pop-up menus. The query that you are building will be displayed on the **Dialog** line. You can edit the query anytime before the command *Done* on the pop-up menu is selected. Once the command *Done* is chosen, the query built by you will be executed.

*Building Query.*

The result will then be displayed on the **Query List** and the **Summary Data** sections of the spreadsheet. If no person is found for the requested query, only the attribute-labels of the queried relation(s) will be displayed.



There are five types of pop-up menus for building a query. Each of them is described below.

– **Query Menu**

The present *Query Menu* looks like the following:

Query Menu
Global Information
Anthropometric Groups
(
Abort

This is the first pop-up menu which appears in building a query. The command *Global Information* or *Anthropometric Groups* allows you to build a query on these data. Selecting either of these two commands will lead to the second type of pop-up menu. The *(* command allows you to construct complex query strings through the use of parenthesis, an auto-completion feature is available to match all unclosed parentheses. The command *Abort* allows you to quit the loop of *Query DB* without executing the query. This is useful for scrapping the query and starting over if you do not like the one under construction.

*Global Information.*

– **Global Information or Anthropometric Group Menu**

This is the second pop-up menu that will show up when building a query. The present *Global Information Menu* looks like the following:

Global Information
Gender
Mass
Stature
Strength Type
Handedness
Fatigue
% Lean Mass
Previous Menu

This menu allows you to query the global information listed. Selecting any item from this menu will lead to the selected global data menu which provides you with the available choice of values. For example, picking *Strength Type* will lead to the *Strength Type Menu* that provides three possible strength types for you to choose from. The *Strength Type Menu* looks like this:

Strength Type
Isometric
Isokinetic
Isotonic
Previous Menu

The present *Anthropometric Group Menu* looks like the following:

Anthropometric Group
Girth
Joint Limits
Center of Mass
Strength
Previous Menu

This menu allows you to choose an anthropometric group to query. After picking the group from this menu, the selected anthropometric group menu will appear. For example, picking *Girth* will lead to the *Girth Menu* which lists all the segments of a human figure. You can choose any one of these segments to query. The present *Girth Menu* is shown below.

Girth Menu
Top Head
Bottom Head
Neck
Upper Torso
Center Torso
.
.
.
Lt Toes
Rt Fingers
Lt Fingers
Previous Menu

#### – Axis Menu

In a human figure, segments are defined in terms of width (x axis), thickness (y axis), and length (z axis) and joint limits are defined in three different rotation axes. This menu allows you to specify the segment or rotation axis. It is shown below.

Axis Menu
X-Axis-Value
Y-Axis-Value
Z-Axis-Value
Previous Menu

– **Relational Operation Menu**

This menu contains operations that are allowed in a query. The present *Relational Operation Menu* looks like the following:

*Operations.*

Relational Operation Menu
Less Than (<)
Greater Than (>)
Less Than or Equal ( $\leq$ )
Greater Than or Equal ( $\geq$ )
Equal (=)
Not Equal ( $\neq$ )
Previous Menu

After an operation in this menu is selected, you will get the following prompt:

Type in value:
----------------

You are expected to enter a number and then hit the <enter> key to get to the next pop-up menu.

– **Conjunction Menu**

The *Conjunction Menu* is shown below.

Conjunction Menu
And
Or
)
Done
Previous Menu

The conjunctions *and* and *or* allow you to combine simple query constructs to form a more complicated one. If the conjunction *and* or *or* is selected, the first menu (i.e. the *Query Menu*) will appear again and the loop of building a query will be repeated. Previously inserted left-parenthesis can be matched using the *)* command. *Done* will stop the loop and send the query that was just built to be executed. Note that every menu except the *Query Menu* contains the command *Previous Menu*. This command allows you to go back to the previous menu and erase the unwanted part of the query. This also enables you to edit the query while building it. If the query is too messy

*Conjunctions.*

to edit, you can execute the command *Abort* in the *Query Menu* to scratch it and start over.

- **Exit Query**

This command allows you to get back to the *Anthropometric Spreadsheet* that is left before entering the *Database Query Spreadsheet*.

- **Create Figs**

This command creates a *Jack* figure file for each of the individuals in the query list. Destination file names are requested from the user via a pop-up dialog box. The type of figure to generate has to be specified in the *Anthropometric Spreadsheet*.

- **Qry History**

A history list is kept internally for all executed queries. You can go back to view the result of a particular query by invoking this command. A dialog box with a scrollable list shows the 50 most recent queries, select one of them by clicking the left mouse button directly over it, followed by the **OK!** button. Click on the **Cancel** button to abort this operation.

- **Extend Qry**

This command allows you to build on the currently displayed query. The *Conjunction Menu* will be invoked once again so that either of *And* or *Or* connectives are once again available for extending the current query.

### 3.5 Exit SASS

Clicking [Quit] exits **SASS**. Also, you may use the hot key <Q> to exit. The difference between this methods of exiting the program is rather important and should be kept in mind at all times. Using <Q> to terminate the program doesn't prevent you from losing the sheet contents. Clicking [Quit] always goes through a protection mechanism that verifies whether changes have been made to the spreadsheet contents, and if so, allows you to save those changes in a file.

### 3.6 SASS in Depth

This section of the manual goes into some of **SASS**'s gory implementation details. It should be skipped in a first reading of this manual. In fact, you should not be concerned too much with how **SASS** operates internally. The following pages are only intended to give you an idea of what goes on.

**SASS** has been designed and implemented keeping an object oriented philosophy in mind. What we mean by object oriented is reflected in the fact that a hierarchy has been established to define the human figure components.

### 3.6.1 The hierarchy of the human figure

The structure used is a hierarchical one (a tree). At the bottom of the tree, the leaves correspond to the segments. The internal nodes correspond to, what we call, the body parts or body objects. The root of the tree is reserved for storing the figure's information. The body parts are composed of body segments, and the figure itself is composed of body parts. One can think of the figure as corresponding to the complete tree. There is another category, the joints, which has been appended to the root of the tree. The joints are the linkages among the segments, and also among the body objects.

*Figure Structure.*

*Linkages.*

A figure can be defined as a collection of body parts, joined together by joints. Each body part, in turn, can be defined as a collection of body segments put together by joints. Each segment has been specified with an access code, a segment type, and a list of sites. Joints are defined similarly. Body objects are specified by a type, an access code, and a list of components, namely a list of segments, joints, and sites related to that object.

It is important to make some remarks here. This hierarchical definition is user definable. Indeed, you can modify the specification of the objects, segments and joints and even the figure itself by just writing down a figure description file `_s_fig_def_xx.dat`. In this way, it is possible to create or delete objects and/or segments as needed.

### 3.6.2 The rule system

**SASS** not only works on relations but also is rule based. As an example, **SASS** currently defines a rule for computing the height of an individual as the sum of the segments' lengths in a path that goes from head to feet. For those segments in the path, the rule allows variation in their lengths if the stature changes and vice versa, to change the stature if the length of any of the segments in the path changes. There is an alternate rule that keeps the stature fixed and adjusts the segments' lengths accordingly, if the length of one of them varies.

*Stature Rules.*

Other rules include changing the mass according to the stature and rules for checking proper bounds in segment (object/figure) dimensions.

### 3.6.3 Rules in SASS: Stature Definition

The stature of the human figure is computed using two different rules. In one case, the stature is kept variable. If the stature varies, the segments' lengths in the stature path vary accordingly. Similarly, if the length of any segments in that path varies, then the stature changes. The underlying criterion for doing these changes is a linear one. The segments in the stature path have been defined as: (head, neck, upper torso, center torso, lower torso, upper leg, lower leg, feet). The length of each of these segments, except for the feet, is computed as the girth value in the z coordinate. For the feet, the length is computed as twice the girth value in the x coordinate (since for the feet, the girth in the z coordinate

*Variable      Stature*  
*model.*

*Stature Path.*

is the longitudinal dimension, and the width corresponds to their height). The doubling factor is due to the fact that in **SASS** the width and thickness (x,y) values are displayed halved. It should be noticed that the thickness and width of the segments are not affected by these changes, for there is no rule to decide the effects of stature changes in these parameters.

The updating process is done carefully, for it might happen that modifying the length of a given segment violates the range of possible stature values, or conversely, if the stature is changed, this change might not be satisfiable by variations in the segments' lengths.

The other case considers fixed stature. The idea is to adjust the segments' lengths along the stature path if the length of one of them varies, such that the global length (stature) remains constant. While this might appear easy to do at first, it is not a trivial matter. To understand why, we must study how the segments' dimensions are obtained. Each segment's dimensions can be seen as a triple (x,y,z) of values. This triple of values, is obtained by interpolation from actual data you provide. This "real world" data corresponds, in fact, to the value of the girth in each of these coordinates for a set of different percentiles (e.g., 5th, 50th, 95th percentiles). **SASS** provides a given triple (x,y,z) for percentiles in the range 1-99 by means of interpolation (also, if you specify a triple, **SASS** provides a percentile value corresponding to that triple). Thus, a segment's dimensions is constrained by the "real world" values range. Furthermore, the stature itself is restricted by a "real" set of values (for each of the percentiles). When you specify a particular change in the triple (z coordinate) of a given segment, the underlying rule attempts to satisfy the constraint of fixed stature, that is, it tries to keep the stature value constant.

*Fixed Stature Model.*

For example, assume the length of the head has decreased. To keep the stature fixed, the lengths of the other segments in the stature path must vary in the opposite way. Currently, the modification is done in a linear way, since there are no rules to define this otherwise. But it might be the case that in the updating process, one of the segment's dimensions (namely length) cannot be satisfied. In other words, the resulting dimension is out of the range established by the 1-99th percentile values. In this situation, the rule sets up the length to its closest limit value (1th percentile value or 99th percentile value), and tries to satisfy the requirement of fixed stature by modifying the remaining segments in the path. (See section 4). Notice that there is a possibility that the stature cannot be kept constant. There is one more step involved in the updating process that will be discussed later. In this mode (fixed stature), if the stature is globally varied, the segments change correspondingly (if possible).

### 3.6.4 Object level

As we discussed before, a figure is built up as a hierarchy. The segments in the lowest level, the body parts (objects) in the next level, and the figure itself as the root level. The body objects are defined (by the user) as sets of segments and

joints. For instance, the object 'leg' is defined by default as a set containing two segments ('upper leg' and 'lower leg') and two sites, and six associated joints. For the matter of the following discussion, it is not relevant what the sites or the joints are, but one can think of a simplified object involving only a set of segments.

The object level is an abstraction of the idea of body parts. So we associate each object with a body part. It is important to keep in mind that the “real world” measurements are done on a segment basis. The objects (body parts) are defined to provide additional flexibility to the user. As the internal structure of each body part can be specified by you, one can consider having as many parts as necessary (or as segments there are). By default, **SASS** has defined eight body parts, namely, head, torso, left arm, right arm, left leg, right leg, left foot, and right foot. These objects encompass most of the (user defined) segments.

*Abstraction.*

*Default objects.*

Having objects allow the user to perform global modifications on a per body part basis, as opposed to doing localized changes on specific segments. Although it is possible to change values for a particular segment, it is generally desirable to be able to do modifications on a body part, as a whole. The idea of having body parts presents some difficulties though. When body parts are introduced, the rule system must consider performing the appropriate (coherent) updates on two different levels simultaneously. If you change values on the segment level, these changes are reflected also at the object level, and conversely, when changes are done in the object level, these changes affect the segment level values. Also, recall that changing the segment level values was governed by a set of rules. There is an equivalent (compatible) set of rules for the object level. For instance, changing stature is governed by rules in the object level (and in the segment level).

### 3.6.5 What is an object?

In a sense, objects can be considered as clusters of segments, and each time an object is accessed, the access is redirected to the corresponding segments, and conversely, if a segment is accessed, all the objects containing that particular segment are accessed. But, there is more under the definition of a body part. Actually, the object's dimensions are approximated by considering the bounding box around the segments of which it is composed. In this way, a body part comes to life as a triple of (x,y,z) values. Why bother doing this? At first it might seem unnecessary, since the components of an object, i.e., the segments have some associated (x,y,z) triples already. However, there are two good reasons that justify our approach. In the first place, using a bounding-box strategy, we can bound the dimensions of the segments (components) of a given object. But also, it allows us to have two sets of dimensions: the expected dimensions and the actual dimensions. The expected dimensions, are those determined by the bounding box approach. These are called expected dimensions since they are precisely those dimensions expected from a bounding-box setting (the usage of

*Object dimension.*

the term “expected” should not be confused with the term “average”; in fact, here expected case should be thought as a worst case, not an average case).

The actual dimensions are the dimensions of the body part when we think of it as a cluster of segments. Thus, the actual dimensions reflects accurately (up to the accuracy of the segments’ dimensions) the dimensions of the object.

Having these two dimension sets provides a way of constraining the growth of the body parts. The following rules come across. If a segment (member) in an object grows (or shrinks) then it should not grow beyond the limits of the object’s expected dimensions for a given percentile, if we want to restrict an object’s dimensions to be of a certain percentile. So we can, for example, try to adjust the dimensions of the other segments in the object’s segment set so that we keep the objects percentile fixed.

*Growth Rules.*

It is important to understand the back and forth process that goes on between objects and segments. On one hand, the global dimensions of the body can be, for instance, those of a 50% (standarized) human being, but we know that all of the body parts need not be 50%. In fact we do not have a rule yet to specify the percentile of the body parts (segment-wise) for a given global body percentile. So, keeping that in mind, we must be able to change dimensions of the body objects (segments) to comply with all the possible compositions of a 50% body, for instance, but we must be careful when specifying other rules for, let us say, *stature*. We need to make sure that a given change of stature does not break any other rules, that is, we must assure that the resulting body composition (i.e., the percentiles of the body parts (objects/segments)) are those valid for a 50% body. Also, we are required to comply with the restrictions on the segments’ (in this case on the stature path) dimensions, i.e. we cannot scale a segment beyond the limits established for that segment by the population data.

*Body Composition.*

Also, we need to assure that the stature modification rules are complied with (i.e. those rules we mentioned before in which the segments’ lengths are modified following a specific layout; currently modifications are done linearly). It seems that a possible solution, in this particular case, is along the following lines. If the stature is modified, then a new global percentile is computed. For that new global percentile, we have a specific rule telling us what the possible compositions are. Thus, we use these compositions as our rules for doing the segment length modification, (instead of doing it linearly as it is done in the current version).

There is no conflict, but that is only if there is a coherent definition of the possible compositions and the stature-path segments’ length, i.e., the compositions must agree with the segments’ length under the population data being used. In other words, the compositions are not unique, they are dependent on the population data used. To illustrate this, suppose we have the following (partial) composition set feet 30%, legs 45%, torso 60%, head 40%,... for a 50% body. Then suppose we want to change the stature in such a way that the resulting body percentile is 60%, and the analogous (partial) composition set is (feet 40%, legs 56%, torso 50%, head 40%,...). Then we scale the objects in



the stature path (which are those listed in the composition sets) to comply with this second composition set. But, we must be sure that there is no conflict in doing so, that is, for instance, the feet might be able only to grow from a 30% to a 40 % under the population data being used.

There is an inherent need for the compositions to be determined under a given population, i.e., different populations will have different compositions. To solve that problem, we must make sure that the scaling (of the segments) resulting out of this complies with the object's (body part) constraint, i.e., the bounding box limitations. This should be the case if we have composition sets that agree at both the segment level and the object level. In the previous example, for instance the compositions were stated at the object level. There must be an equivalent composition at the segment level. Following this example, the segment version of the composition for the 50% figure is, for instance, (... upper leg 45%, lower leg 60%, upper torso 76%, center torso 57%, lower torso 45%, ....), assuming legs decompose into two pieces and torso into three pieces.

But what if the compositions, though based on a particular population data, are not available for all the possible percentiles (with good luck we hope to have one for a few of the percentiles). We would have to interpolate compositions (if it is sound to do that) and make sure a given segment's length is not violated (according to its percentile range) when trying to go from a composition for the 50% figure to that of the 60% figure. If we had only one such composition to work with to account for all possible compositions on the percentiles range, then it would be necessary to make sure that this composition is not violating the range of values a given segment's length can have for the population under consideration. This is basically what happens in the present version of **SASS**. Since we do not have a composition analysis available, we have assumed decompositions are unique for a given population (i.e., one composition for all the percentiles (not one for each)) and furthermore, this composition is linear, i.e., for a 50% figure (feet 50%, legs 50%, torso 50%,...) and similarly for the segment composition (... upper leg 50%, lower leg 50%, ....). This has sensibly increased the difficulty of the problem because such an assumption is far from being applicable to real world situations.

This has ended up in a need for additional rules in **SASS** to verify that there is an agreement among all parts. Recall, for instance, the stature problem. In that case, we are considering compositions to be linear. So we need to be especially careful not to end up with a segment's length violation. To avoid that, we limit the growth of a segment to its 1% and its 99% (i.e., below and above limits). If we do not achieve the desired global growth, i.e, the local segment's growth was not sufficient, then we go and adjust the other segments in the stature path. This is done in an iterative way. Also, observe that we have to keep track of two levels of abstraction, that is the segments and the body parts. It is necessary to double check, once for the segments' lengths not to violate their limits and once for the objects' lengths not to violate their limits. This is necessary because the objects' composition has been assumed to be

linear. A similar situation arises when considering the other way around, that is, modifying a segment's length implies a careful set of steps along the hierarchy to keep track of this modification's effects on the objects' lengths and then the effects of these on the global length (i.e. stature) so that the resulting stature has a value between its percentile limits. (If the stature is kept fixed, then we do not go all the way up in the tree but we need to perform a readjustment of all the other segments (objects) to assure the stature is kept constant, whenever possible.)

## 4 Tricks

There's nothing new in this chapter; it simply documents some tricks that have proven useful for **SASS** sessions.

- **SASS** girth sheet is goal oriented. When defining a particular value for the stature or for a specific segment or object, **SASS** will try to satisfy the current stature constraints. Because segment/objects dimensions vary within a range, **SASS** may find that in keeping the stature constant or in modifying the stature to a certain value, it has reached a point in which one of the segments/objects in the stature path is at its maximum or minimum range value, so the program is going to stop at this point and provide you with a stature (or segment/object) value different from what you specified. You can ask **SASS** again to satisfy the particular value you specified before. In fact, you may continue doing this a few times. The program will try to achieve the goal by resizing other segments/objects along the path, and stop each time one of the segments reaches one of its limits. If you want to avoid this when trying to set a specific stature, you should go to the segment sheet, <s>, and modify the segments along the path yourself. In other words, for segments/objects in the stature path, when modifying their z (length) values, the value you type in at the prompt is taken by **SASS** to be a goal. So you might observe that you type for instance 5th, and **SASS** gives you another value (usually close to the one you specified). **SASS** stops every time a segment lower or upper limit is exceeded. You must continue to specify the desired value until it is achieved. This shouldn't take more than a few tries, if the goal is attainable at all.
- Because there are no rules as to what is the correct proportionality of segments for a given percentile body, selecting of a specific global group percentile, and then generating a figure file or scaling file will cause all segments in the body to be scaled to this given percentile value. For a more sensible scaling, after setting the global group percentile, use the height percentile to set the scaling generated to be within the population stature range. Once a given percentile height is established, scaling of the segments is propagated automatically by **SASS**. Notice that this propagation is linear, and affects only the length (z-axis) of the segments along the stature path. For example, suppose we want a figure of 95th percentile. Set the global group percentile to 95. Then correct the stature path segments by setting the stature percentile first to 95th.
- In the main spreadsheet, the values for the width (x-column) and the thickness (y-column) are displayed halved. So when considering on doing changes in this to columns, keep this in mind. The length values (z-column) are displayed in full.

- Learn to use the hot keys. They save you a lot of time. Alternatively, learn to use the pull down menu. However, it is usually faster to use the hot keys.
- If you are trying to fit a figure within an environment in *Jack*, use multiple scaling files, instead of creating multiple figure files for the different percentiles. Loading figure files in *Jack* takes a lot more time than it takes to load a scaling file. Even better, use the port command to do an interactive fitting.
- When creating figure files the .fig extension for the file name is optional (so do not type it) . The same goes when creating scaling files. Using a .jcl extension is optional. Similarly, when saving the spreadsheet contents into a file, the .sas extension is optional, as it is when reading a contents file.
- When using a port connection with *Jack*, be careful to specify **SASS** (a *Jack* command) in *Jack* before you attempt an interactive scaling.
- Observe that pressing <Q> (or clicking [**Terminator Quit**] in the pull down menu) will NOT allow you to prevent an accidental lose of the spreadsheet contents. If you know what you're doing, this is the fastest way to exit. However, if you want to stay on the safe side, exit the program by clicking [**Quit**] in the command pad. This method always checks for changes in the spreadsheet contents before exiting the program.

## 5 Bibliography

- [NATICK 88] 1988 Anthropometric Survey of U.S. Army Personnel; Methods and Summary Statistics; Natick Technical Report TR-89-044, 1988.
- [NASA 87] Man-Systems Integration Standards; NASA-STD-3000, vol 1, 1987.
- [Pandya 92a] Pandya, Abhilash et al.; **The Validation of a Human Force Model To Predict Dynamic Forces Resulting From Multi-Joint Motions**; NASA Technical Paper 3206; NASA; 1992.
- [Pandya 92b] Pandya, Abhilash et al.; **Correlation and Prediction of Dynamic Human Joint Strength from Lean Body Mass**; NASA Technical Paper 3207; NASA; 1992.

## 6 Appendix

### 6.1 Database Format

The general format of all .db files are as follows:

- Fields are separate by comma
- Each line corresponds to a record of fields. There must be equal number of fields in each record.
- String fields can have spaces.
- The first field is always the ID number of a subject.

The individual files have the following fields:

- person.db
  - ID number
  - Name
  - Gender
  - Stature
  - Mass
  - Handedness
  - Age
  - Description of data
  - Data source
- strngth\_param.db
  - ID number
  - Side (Left or Right)
  - Type of Strength
  - Fatigue Level
  - % Lean Mass
- girth.db, cmass.db, jntlmt.db
  - ID number
  - Segment Name
  - X value
  - Y value
  - Z value

## 6.2 Hot Keys

Command	Speed-key(s)
Help	<?>
Quit	<Q>
Select Contour	<n>
Select Polybody	<p>
Select Object Mode	<o>
Select Segment Mode	<s>
Select girth	<g>
Select jntlmt	<j>
Select center of mass	<c>
Select strength	<t>
Select male	<m>
Select female	<f>
Dynamic Stature Model	<dv>
Static Stature Model	<ds>
Database	<D>
Write to <i>Jack</i>	<w>
Repeated write to <i>Jack</i>	<r>
Create figure	<b>
Create scaling	<k>
Save contents	<S>
Read file	<R>
Local clean up	<L>
Global clean up	<G>
Strength Subject	<V>

### 6.3 Pull-down menu

Command	Menu box
Global clean up	[Misc]
Local clean up	[Misc]
Help	[Misc]
Quit	[Misc]
Select Contour	[Figure]
Select Polybody	[Figure]
Select male	[Figure]
Select female	[Figure]
Select Object Mode	[Modes]
Select Segment Mode	[Modes]
Dynamic Stature Model	[Modes]
Static Stature Model	[Modes]
Create figure	[Creation]
Create scaling	[Creation]
Save sheet contents	[Creation]
Read *.sas file	[Creation]



## 6.4 Contents by Topic

### General information

Cell Select	3.1.3	Dialog Line	3.1.7
Dialog Box	3.1.8	Global clean up	3.1.16
Help	3.1.12	Installing SASS	1.3
Local clean up	3.1.16	Menu (pull-down)	6.3
Mouse Select	3.1.11	Quit	3.5
Read file	3.1.14	Save sheet	3.1.15
Scroll	3.1.10	Speed Keys	3.1.5
Tricks	4	Units	3.1.4

### Anthropometry Stuff

Anthropometry Sheet	3.1	Command Menu	3.1.4
Data Section	3.1.3	Gender Selection	3.1.2
Summary Section	3.4.1		

### Group Stuff

Groups	3.1.1	Group Percentile	3.1.2
Group Status	3.1.1		

### Query Sheet Stuff

Query	3.4	Query Command Menu	3.4.4
Query Section	3.4.2		

### File Stuff

Figure File	3.1.4	Scale File	3.3.1
-------------	-------	------------	-------

### Stature Stuff

Model Select	3.1.13	Stature Rules	3.6.3
--------------	--------	---------------	-------

### Strength Stuff

Strength sheet	3.2
----------------	-----

### Port Stuff

SASS-JACK	3.3
-----------	-----



Anthropometric Group Status	
Global data	Command Menu
Data Section	
Dialog line	

Figure 2: Anthropometric Spreadsheet Screen Layout

Query DB	cm $\longrightarrow$ in
Input Data	HELP
Create Figure	Quit

Figure 3: Command Menu for Anthropometric Spreadsheet



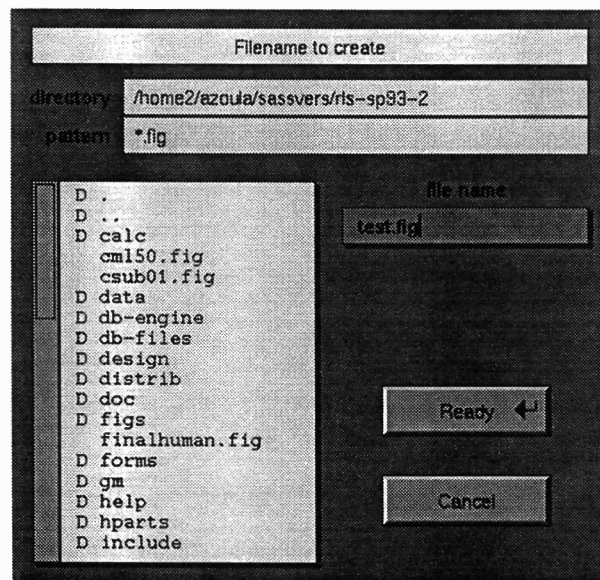


Figure 5: Dialog Box Display

SASS window											
GIRTH			JOINT LIMITS			CENTER OF MASS			STRENGTH		
POPULATION: NASA Strength Data											
FIGURE TYPE: Poly Body			STRENGTH TYPE: ISOKINETIC			ft-lb->N-H		right->left			
GENDER: Male			SOMA: 15%			MOTION SPEED: 60.00 deg/sec		Query DB			deg -> rad
MASS: 85.02kg			79.16%			STRGTH MODE: PREDICT		Input Data			HELP
STATURE: 182.72cm			79.16%			LB FACTOR: 10.40%		Create Fig			Quit
GROUP PERCENTILE: 50.00%			FATIGUE LEVEL: 1								
Motion Impetus (right)		Body Configuration / Joint Angles deg							Resultant Strength		
		Shoulder			Elbow	Wrist			Value (ft-lbs)	-	
		x	y	z	y	x	y	z			
S h o u l d e r	Abduction	66.47	-	-	-	-	-	-	37.07	-	
	Adduction	66.47	-	-	-	-	-	-	37.22	-	
	Extension	-	63.10	-	-	-	-	-	40.72	-	
	Flexion	-	63.10	-	-	-	-	-	25.86	-	
	Lateral	-	-	341.48	-	-	-	-	17.15	-	
	Medial	-	-	341.48	-	-	-	-	21.80	-	
E l b o w	Extension	-	-	-	74.88	-	-	-	29.30	-	
	Flexion	-	-	-	74.88	-	-	-	22.06	-	
W r i s t	Radial	-	-	-	-	356.77	-	-	7.34	-	
	Ulnar	-	-	-	-	356.77	-	-	8.54	-	
	Extension	-	-	-	-	-	9.55	-	6.36	-	
	Flexion	-	-	-	-	-	9.55	-	3.56	-	
	Pronation	-	-	-	-	-	-	356.27	5.18	-	
	Supination	-	-	-	-	-	-	356.27	4.91	-	
Press LEFTMOUSE to select items											

Figure 6: Strength Sheet Display

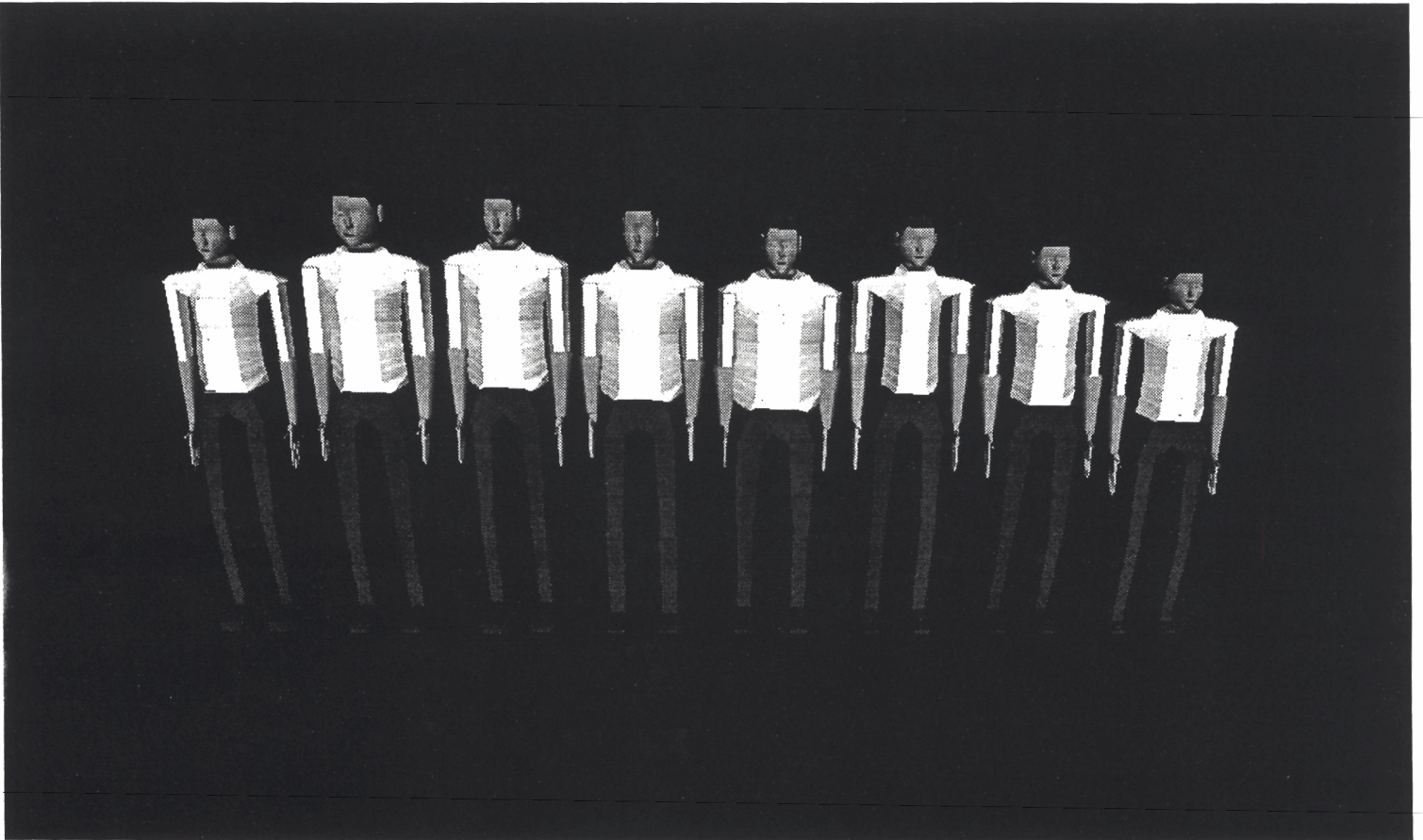


Figure 7: Human Figures Created by SASS - Frontal



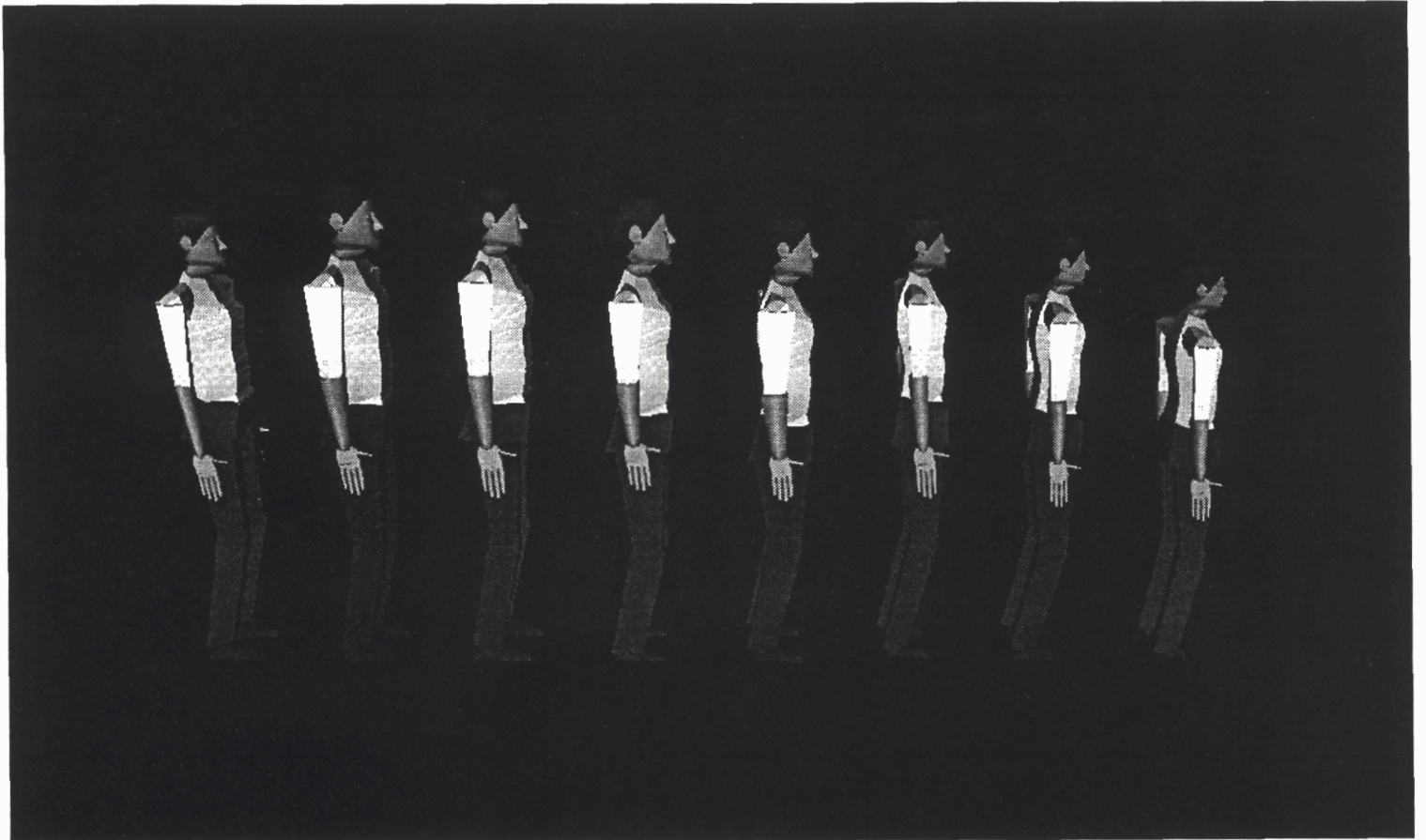


Figure 8: Human Figures Created by SASS- Lateral

Summary Data	Command Menu	Scroll Buttons
Query List		
Dialog Line		

Figure 9: Database Query Spreadsheet Screen Layout.



